1.0 INTRODUCTION

URS Corporation (URS), on behalf of the Seattle District of the U.S. Army Corps of Engineers (USACE), conducted a site investigation (SI) at the former USACE North Pacific Division (NPD) laboratory, located in Troutdale, Oregon (Figure 1-1). URS conducted this SI under contract number DACA67-98-D-1005, delivery order number 73, according to the guidelines and specifications described in the *Final Management Plan, Site Investigation, Former North Pacific Division Laboratory, Troutdale, Oregon* (URS 2001).

Section 2 summarizes the SI field activities and analytical results, and Section 3 summarizes data quality. Section 4 presents a conceptual site model that includes site geology and hydrogeology, beneficial water use, land use, human health and ecological risk evaluations, analytical results, and comparison to screening values. Conclusions are provided in Section 5.

1.1 BACKGROUND

1.1.1 Site Description

The former NPD laboratory facility (the site) is located at 1491 Northwest Graham Road on 6.43 acres of property in the city of Troutdale, in Multnomah County, Oregon (Figure 1-1). The property is located within the southwest quadrant of Section 24, Township 1 North, Range 3 East (USGS 1993). In its present configuration, the site consists of a northern parcel and a southern parcel of land divided by Northwest Graham Road. The area is primarily industrial and is zoned for general manufacturing.

Existing structures on the southern parcel consist of a 65,000-square-foot building that formerly housed the USACE NPD materials testing laboratory and a warehouse (Figure 1-2). There are two small buildings to the east of the main building. These buildings were used for storage of hazardous materials and oil drums. A small fenced enclosure with a concrete pad adjacent to the east side of the building is reported to have been used to enclose an electrical transformer; six pole-mounted transformers sit directly above it. Two large mobile trailers north of the main building are currently used by Mount Hood Community College.

The southern parcel is bordered to the north and east by Northwest Graham Road, and to the south by the Troutdale Airport. A warehouse is located on the adjacent property to the west of the site and is occupied by the U.S. Forest Service. Land to the east is occupied by a construction company and other commercial properties.

The northern parcel is undeveloped and occupied by a landfill that covers approximately one-third of an acre. It is bordered to the north and west by undeveloped land owned by the Reynolds Metals Company (RMC), to the south by Northwest Graham Road, and to the east by the new City of Troutdale wastewater treatment plant.

1.1.2 Site History

The NPD laboratory operated at the site from 1949 until the spring of 1997. The laboratory conducted materials testing for the entire duration of operation. In 1979, the NPD property was divided by an easement for the extension of Northwest Graham Road. In 1986, the laboratory expanded operations within the warehouse facility and began analyzing quality assurance (QA) split samples collected during Hazardous, Toxic, and Radioactive Waste (HTRW) investigations conducted by the USACE and its contractors. Environmental samples were analyzed until the cessation of operations in 1997. In addition to the permanent buildings, mobile trailers have been located at the site. The trailers once housed the USACE Portland Resident Office and are now occupied by Mount Hood Community College.

The main building has several sink and floor drains that lead to a common drain header outside the building and then to the concrete sump on the east side of the building (Figure 1-2). All drains, except for those from the lavatories and the freeze/thaw room, discharged to this sump. The lavatory drains discharged directly to the sanitary sewer, and freeze/thaw drains discharged directly to the drainage ditch. The sump discharged into the drainage ditch, which runs along the eastern margin of the site. In 1996, the effluent from the sump and lavatories was connected to the local sewer system. In addition, two concrete raceways served as floor drains within the building and discharged directly into the drainage ditch until they were blocked in 1996. The soils within the drainage ditch are coarse-grained and highly permeable, which generally promotes infiltration of the discharged liquids into the underlying soils. The drainage ditch terminates just north of the property.

The drainage ditch reportedly received untreated discharges from the laboratory materials testing operations (Tetra Tech 1999). The discharges included wastewater generated during washing and testing of soils, aggregate, and concrete, and from wet chemistry water quality testing. This wastewater had typical concrete admixtures such as lignins and sulfates. The reagents associated with water quality testing included large quantities of mercury and silver salts. These reagents were routinely flushed down the drains. Other discharges flushed down the sink drains included acids and bases, and trace amounts of laboratory solvents such as methylene chloride, acetone, and hexane. Dilute solutions of metals (less than 1 part per million [ppm]), and indicator dyes such as methylene blue and green, were also disposed of in the sinks. Samples received from HTRW investigation sites were containerized and appropriately disposed of offsite.

A dry well existed in the southeast portion of the site from 1950 until 1999, when it was removed and the surrounding soil was excavated and removed. The dry well was used for waste disposal from 1950 until 1981. The dry well was constructed of approximately 20 inches of gravel overlying the native soil and a 9-inch-diameter vertical, open-ended, concrete pipe. The gravel layer extended beyond the vertical pipe for an unknown extent. Viscous wastes were poured directly into the dry well for disposal. The wastes included oil-based paint and asphalt samples that had been dissolved in solvents. Polychlorinated biphenyls (PCB hydrocarbon mixtures), lead, chromium, and cadmium may have been in the paints tested at the laboratory. A zinc powder was used in paint testing at the laboratory. The solvents used included ether, benzene, and 1,1,1-trichloroethane (TCA) mixed with alcohol. In addition, trichloroethene may have been used as a solvent prior to the late 1970s. The asphalt that was tested may have contained PCB hydrocarbon mixtures and oils. Disposal of these materials in the dry well was discontinued sometime in 1980 or 1981. A conservatively high estimated total of 45 gallons of dissolved paint and asphalt samples were disposed of in the dry well between 1950 and 1981.

A 10,000-gallon storage tank located west of the main building was decommissioned and removed in 1993. The tank was partially underground in a concrete vault. It was used to store oil for the boiler-fired heating system in the building. Approximately 10 cubic yards of contaminated soil were excavated during the tank removal activities.

Material sampled from the Umatilla Army Depot Borrow Site in 1994 remained at the site after the laboratory closed. The material consisted of sand and gravel contained in 33 five-gallon plastic buckets.

1.1.3 Landfill Concrete Evaluation

In 1952 the U.S. Atomic Energy Commission requested that the NPD laboratory perform materials testing of concrete used in bench- or pilot-scale experiments at the Hanford nuclear reservation (Borge 1997). The experiments involved a chemical separations process that used solvent extraction to remove plutonium nitrates and plutonium oxides from irradiated uranium (Stang 1997), called the plutonium-uranium extraction, or Purex, process. The refined plutonium that was one of the products of this process was then used for nuclear weapons production during the Cold War.

The information in this section about Hanford concrete testing at the NPD laboratory comes from two telephone interviews by the USACE with former NPD laboratory director Orville Borge, who worked at the laboratory between 1950 and 1981 (Borge 1997, 2001). No direct written documentation was provided to URS to either support or contradict the information provided by Mr. Borge. Information regarding the Purex process was found at web sites addressing Hanford site history and general Purex process chemistry.

NPD Laboratory Testing

Mr. Borge stated that the NPD laboratory testing of Hanford concrete samples was conducted in 1952. The Purex plant had not yet been built at that time; it did not begin operating at Hanford until 1955. The year provided by Mr. Borge coincides with the time when small-scale testing was conducted at Building 321 at Hanford. Specifically, between 1950 and 1955, the reclamation of uranium and plutonium by extraction processes was tested on a small-scale basis in Building 321 using low-level radioactive solutions. A building addition to Building 321 was constructed in 1952 to house a prototype Purex plant (Hanford CRL 1997). It is possible that the concrete testing at the NPD laboratory may have been related to waste produced during the bench- or pilot-scale chemical analyses being conducted in Building 321.

According to Mr. Borge (2001), the NPD laboratory poured 12 concrete "beams" and shipped them to Hanford, where half of the beams were irradiated and the remaining beams were reportedly soaked in nonradioactive Purex process chemicals. All 12 beams were shipped back to the NPD laboratory for strength testing. The beams reportedly measured approximately 3½ inches by 4½ inches by 16 inches (Borge 2001). The purpose of the analysis was reportedly to test "different concrete mixtures for shielding concrete to be used for high-level radioactive waste tanks at Hanford" (Borge 1997). Concrete and lead are some of the more common materials that have been used for radiation shielding (Atlantic Nuclear 2002; Metalico-Evans Co. 2002; Lead Industries Assoc. 2002). Hanford is noted to have used lead, iron, and solid lead-cadmium jacketed in aluminum for shielding cylinders and plugs (B Reactor Museum Association 2002). One source stated that Hanford single-shell tanks, which received effluent from Purex processing, were constructed of a single layer of carbon steel, reinforced with concrete (Cryocell 2002).

Purex Process Chemicals

The chemicals used in the Purex process at Hanford were sodium hydroxide (and perhaps potassium hydroxide), nitric acid, tributyl phosphate, and kerosene (Gephart n.d.). The first step of the Purex process at Hanford was the removal of the aluminum cladding that encased the irradiated uranium using sodium hydroxide, which liquefied the aluminum. This aluminum-caustic waste stream was transferred to a waste tank (Freer 1999). The next step involved dissolving the uranium into a slurry by adding nitric acid. The final step was a series of successive oxidations, reductions, extractions, and back extractions that isolated the radioisotopes and created highly purified uranium and plutonium. Tributyl phosphate in a kerosene-type diluent was employed at Hanford as the organic solvent for the extractions (Albright et al. 1999). No NPD laboratory records were available to indicate which, if any, of these chemicals were used on the concrete beams.

Concrete Sample Chemistry in Landfill

Of the known nonradioactive Purex process chemicals that could have been used to treat the concrete beams, none of them is particularly toxic. The hydroxides and acids are corrosives; tributyl phosphate is readily biodegradable in the environment, according to one source (Solutia 2001). Another evaluation of the risk of tributyl phosphate is found in an U.S. Environmental Protection Agency (EPA) ranking of 879 chemicals based on persistence, bioaccumulation, and toxicity to both human and ecological receptors. Tributyl phosphate ranked "10" (with 1 posing the least risk and 18 the greatest; many chemicals received the same risk ranking) (USEPA 1997). There was no prioritization between human health and ecological risk; tributyl phosphate was determined to rank low in persistence (both human health and ecological), medium in bioaccumulation (both human health and ecological), and low in human health toxicity (but high in ecological toxicity). Discussions with URS chemists indicate that it is unlikely that the concrete would have leached any of these chemicals to the underlying or surrounding soil.

Mr. Borge indicated that after the 12 beams had been tested at the NPD laboratory, they were broken up as part of the strength testing and then placed in the NPD landfill. As regards radioactivity, Mr. Borge stated that a Geiger counter was used at the NPD laboratory to test the beams and reportedly no radiation was detected. Mr. Borge reported that the concrete beams treated by Purex chemicals were returned to the NPD laboratory coated with a ½-inch-thick brown crust. *If* there was any testing of lead as concrete liners, it is possible that the brown crust could have been a precipitate formed from the interactions of the lead and the process chemicals. Any conclusions in this arena, though, would be conjecture.

1.1.4 Previous Investigations

Preliminary Assessment—1991

A preliminary assessment (PA) was conducted for the site in 1991 by the USACE (USACE 1991). The former NPD laboratory had been identified as a large quantity generator under the Resource Conservation and Recovery Act (RCRA) regulations in 1991 for disposal of methanol from the concrete freeze/thaw test apparatus. The PA documented past and current waste handling and disposal practices of the laboratory. Based on the results of the PA, the EPA recommended no further action at the site. This finding was rescinded by the EPA in October 2000.

Underground Storage Tank Removal—1993

Martech USA Inc. (Martech) was tasked by the USACE to remove one 10,000-gallon storage tank located near the main building at the site. The tank was buried within a concrete vault with sand to a depth of 6 feet. The vault consisted of four walls with footings; there was no concrete bottom. Approximately half of the tank and vault were above ground. The tank reportedly was used to store No. 5 fuel oil for heating purposes.

In March, 1991, the tank was removed from service and the remaining fuel (3,401 gallons) was emptied from the tank by another party. Martech removed the tank in 1993. The final confirmation sampling analytical results identified diesel-range petroleum hydrocarbon contamination in the subsurface soils located within the concrete vault at maximum concentrations of 1,830 milligrams per kilogram (mg/kg). As a result, a total of 10 cubic yards of petroleum-contaminated soils were excavated from the vault and transported offsite for disposal. Petroleum hydrocarbons were not detected in the two samples collected from directly beneath the tank. The concrete vault was removed and demolished within the excavation, which was backfilled and compacted to grade. Results of confirmation samples collected from outside the vault indicated that the contamination was limited to within the concrete vault (USACE 1998).

Environmental Review Guide for Operations—1994

In 1994, an internal compliance assessment was performed at the site for the Portland District USACE by Woodward-Clyde Consultants (Woodward-Clyde 1995), under the Environmental Review Guide for Operations (ERGO) program. The assessment included a site visit and a review of all past and present waste management procedures and identified several areas of concern:

- Solid waste disposal in the unlined landfill on the northern portion of the property

- Collection of wastewater from the laboratory drains into the sump, and subsequent discharge of wastewater to the drainage ditch

- Disposal of viscous chemical waste in the shallow dry well

The associated report made several recommendations to prevent further impact of soil and water at the site:

- Discontinue any of the above practices still taking place
- Connect the sump to the sanitary sewer system
- Characterize and dispose of all waste and samples still stored on the site
- Properly abandon an unused water well present on the site

All of the recommendations were implemented and no further actions were taken at that time.

Preliminary Site Characterization—1995

In 1995, the USACE implemented a limited soil sampling program at the site to assess the potential impacts of laboratory disposal practices to the drainage ditch and dry well area. One surface soil sample was collected from the drainage ditch and analyzed for the presence of metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs). Arsenic and chromium were detected at concentrations that exceeded EPA screening levels that were current in 1995.

Two samples were collected from the dry well area, including one in a tar layer at the base of the gravel (approximately 20 inches below ground surface [bgs]), and the other from the native soil beneath the tar and gravel. These samples were analyzed for the presence of metals, VOCs, SVOCs, and PCB hydrocarbon mixtures. The results indicated that chromium, Aroclor® 1260, TCA, toluene, and bis(2-ethylhexyl)phthalate were detected in the tar sample at concentrations greater than EPA screening levels. Oil-range hydrocarbons and mercury also were detected.

Environmental Baseline Survey—1997

In 1997, Tetra Tech, Inc. was contracted by the USACE to conduct an Environmental Baseline Survey (EBS) of the site to determine whether adverse impacts to the environment had occurred as a result of laboratory activities. Soil and groundwater samples were collected and analyzed for VOCs, SVOCs, and RCRA priority pollutant metals at the sump, drainage ditch, dry well area, and landfill (Tetra Tech 1997).

The most significant impacts to the environment identified were elevated metal concentrations (at levels higher than background levels) in the drainage ditch soil and in four groundwater samples (Table 1-1). The study did not include any remedial action but identified several areas of concern for further action.

Groundwater Survey—1998

Six monitoring wells were installed at the site to investigate the metals identified in groundwater in the 1997 EBS (Tetra Tech 1997). Tetra Tech sampled each well in April and May of 1998 (Tetra Tech 1998). Results of the April sampling indicated that total arsenic, lead, and cadmium concentrations exceeded EPA screening levels. The May 1998 results indicated that total arsenic and lead concentrations exceeded EPA screening levels only in shallow samples collected from the northern portion of the site. Dissolved metals were not detected above screening levels in groundwater samples collected from either sampling event. Based on these findings, Tetra Tech recommended one additional sampling event be conducted to document groundwater quality following the dry well and drainage ditch soil removal.

Soil Removal and Groundwater Sampling—1999

Tetra Tech, under contract to the USACE, conducted soil removals at the site in the drainage ditch and dry well area (Tetra Tech 1999). Approximately 30 cubic yards of soil were removed from the drainage ditch and disposed of offsite. No obvious signs of contamination were noted by field personnel. The total excavation measured 5 feet east to west and 40 feet north to south and averaged 4 feet deep. Concrete cores were encountered during the excavation. Some were removed from the site and disposed of as investigation-derived waste. Other cores remained in place in the drainage ditch. Groundwater was encountered at 4 feet bgs during the excavation. Soil samples were collected from the walls of the drainage ditch excavation to confirm that all contaminated soil had been removed (Table 1-2).

Twenty-five cubic yards of soil were removed from the dry well area and disposed of offsite. The dry well excavation was centered on the former dry well and measured 8 feet east to west, 14 feet north to south, and 5.5 feet deep. Soil samples were collected from the sidewalls and bottom of the excavation to confirm that all contaminated soil had been removed (Table 1-2). Subsurface structures of a brick wall with an approximately 1.5-inch horizontal pipe were noted and left in place. Staining was evident in the gravel at 2.5 feet bgs, but no other evidence of contamination was apparent. The tar layer that had been encountered in 1995 was not encountered in 1999.

Samples of groundwater that pooled in the excavations and from the groundwater monitoring wells were collected. No contaminants were detected above screening levels in the grab soil samples collected from the dry well area and drainage ditch soils. Metals in standing water collected from the drainage ditch and groundwater from monitoring wells exceeded screening levels (Table 1-2).

The USACE entered into the Oregon Department of Environmental Quality (ODEQ) independent cleanup pathway in August 1999. In December 1999, ODEQ reviewed and commented on previous investigations and cleanup actions taken at the site.

1.2 PURPOSE OF INVESTIGATION

The objectives of this SI were to evaluate whether contaminated soil remains at locations where soil removal activities were conducted previously; to assess whether past laboratory activities, including the use of the landfill, have adversely impacted soil or groundwater quality beneath the former NPD laboratory site; and to evaluate whether contamination that may pose a threat to human health or the environment exists at the site. This SI was designed to address outstanding issues identified by the EPA and ODEQ at the site.

This SI was completed to fill data gaps remaining after previous investigations at the site. Soil, sediment, groundwater, and concrete samples were collected during this SI for the following purposes:

- To collect the data needed to better define the type and extent of groundwater, soil, sediment, and concrete contamination
- To evaluate whether previous removal of contaminated soil was complete
- To assess whether pole-mounted transformers have adversely impacted the soil around the existing transformer pad
- To evaluate potential adverse impacts to the environment from past laboratory activities
- To determine the concentration of potential contaminants in the Umatilla Army Depot Borrow Site material stored at the site

Table 1-1
Contaminants Detected During the 1997 EBS

Area Investigated	Analysis		
	VOCs	SVOCs	Leachable Metals
Wastewater collection sump (soil)	ND	ND	ND
Sump area groundwater[a]	ND	ND	Barium, chromium, and lead
Drainage ditch (soil)	NA	ND	Arsenic and mercury (total)
Drainage ditch area groundwater[a]	ND	ND	Ten EPA CLP-list metals detected.
Dry well[b] (soil)	ND	ND	ND
Dry well area groundwater[a]	ND	ND	11 CLP-list metals detected below MCLs
Landfill (soil)	ND	ND	ND
Landfill area groundwater[a]	ND	ND	14 CLP-list total metals were detected below MCLs
Groundwater monitoring wells	NA	NA	Total arsenic, cadmium, and lead

[a]Groundwater samples were analyzed for total and dissolved metals.
[b]Aroclor® 1260 and heavy-oil-range hydrocarbons also were detected in this sample.

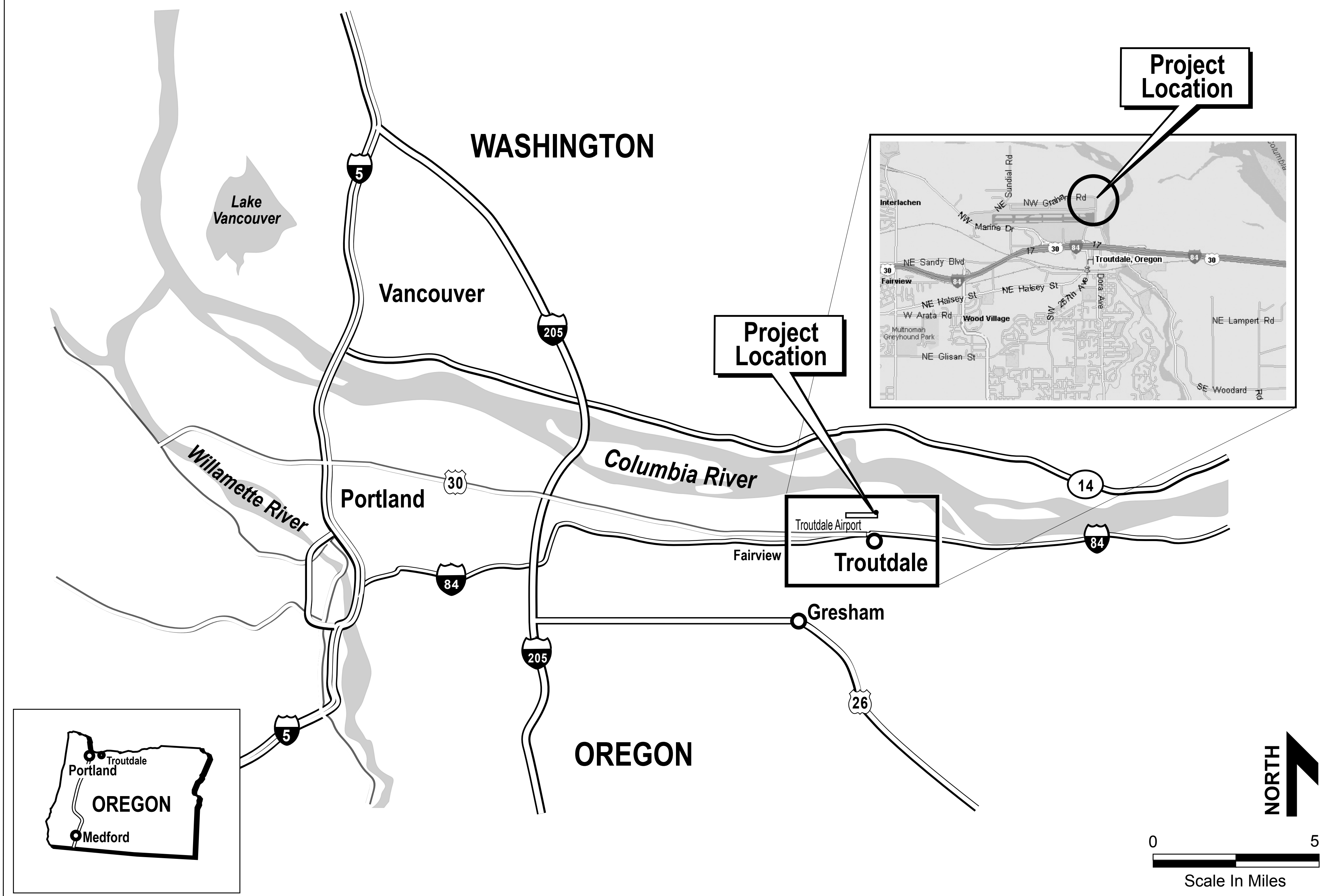
Notes:
CLP - Contract Laboratory Program
EPA - U.S. Environmental Protection Agency
MCL - EPA maximum contaminant level for drinking water
NA - not analyzed
ND - not detected
SVOCs - semivolatile organic compounds
VOCs - volatile organic compounds

Table 1-2
Contaminants Detected During the 1999 Soil Removal and Groundwater Sampling

Area Investigated	Analysis			
	Diesel-range TPH	**PCB Hydrocarbon Mixtures**	**Total Metals[a]**	**Leachable Metals[b]**
Soil and Standing Water				
Drainage ditch (soil)	NA	NA	None exceeded Oregon industrial screening values concentration	ND
Standing water from the drainage ditch	NA	NA	Total lead and mercury greater than MCLs; Dissolved arsenic less than MCLs	Not applicable
Dry well (soil)	Less than Oregon UST soil matrix value	ND	NA	NA
Area Investigated	**Alkalinity**	**Anions**	**Total Metals[c]**	**Dissolved Metals[c]**
Groundwater				
Groundwater monitoring wells	Calcium carbonate detected in concentrations ranging from 14.6 to 234 mg/L	Chloride and sulfate detected at concentrations less than the MCLs	Iron and cadmium detected at concentrations greater than MCLs	Iron detected at concentrations greater than the MCL in one sample

[a]Total arsenic, aluminum, mercury, and lead
[b]Arsenic, cadmium, mercury, and lead
[c]Arsenic, cadmium, lead, mercury, calcium, manganese, magnesium, potassium, sodium, and iron

Notes:
EPA - U.S. Environmental Protection Agency
MCL - EPA maximum contaminant level for drinking water
mg/L - milligram per liter
NA - not analyzed
ND - not detected
PCB - polychlorinated biphenyl
TPH - total petroleum hydrocarbons
UST - underground storage tank



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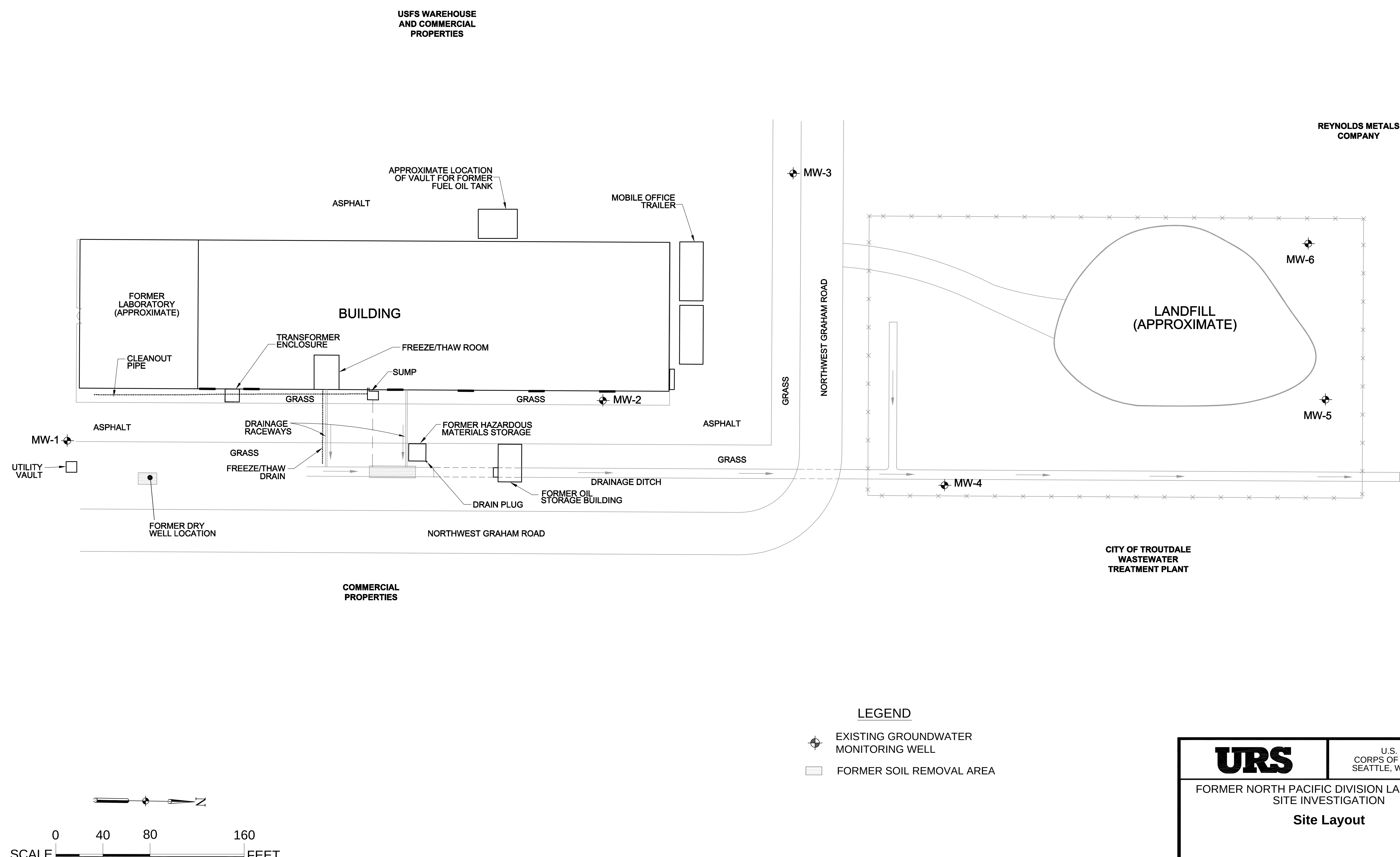
SITE INVESTIGATION
Former NPD Laboratory
Troutdale, Oregon
USACE, Seattle District

Figure 1-1
Site Location



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URS

U.S. ARMY
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

FORMER NORTH PACIFIC DIVISION LABORATORY
SITE INVESTIGATION

Site Layout

TROUTDALE, OREGON

FIGURE 1-2